

1 Beam energy dependence of fifth and sixth order cumulants and
2 factorial cumulants of net-proton and proton distributions in
3 Au+Au collisions from BES-I program at RHIC-STAR

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5 **Abstract**

6 Cumulants of net-baryon distributions are predicted to be sensitive observables in the study
7 of the QCD phase diagram. The cumulants ratios are related to the thermodynamic suscep-
8 tibilities which can be obtained from lattice QCD calculations. Furthermore, higher order
9 proton factorial cumulants are also suggested to carry signals of first order phase transition
10 between hadronic phase and the QGP, where the proton multiplicity distributions could become
11 bimodal. Recently, STAR measurements on net-proton cumulant ratio C_4/C_2 in most central
12 (0-5%) Au+Au collisions are found to exhibit non-monotonic collision energy dependence, which
13 is qualitatively consistent with expectations from a QCD-based model which includes a critical
14 point[1,2].

15 We report the measurements of fifth and sixth order cumulants and factorial cumulants of
16 net-proton and proton distributions, respectively, in Au+Au collisions from $\sqrt{s_{NN}} = 7.7 - 200$
17 GeV, recorded by the STAR detector in the phase I of Beam Energy Scan (BES-I) program at
18 RHIC. The protons and antiprotons are selected at mid-rapidity $|y| < 0.5$ within $0.4 < p_T < 2.0$
19 GeV/c. The measurements will be compared with lattice QCD calculations ($\mu_B \leq 112$ MeV)
20 and expectations from a QCD inspired model calculations at higher μ_B . Also, in order to
21 understand non-critical effects, comparison of the measurements with those obtained from the
22 transport (UrQMD) and thermal (HRG) models will also be presented.

23 **References**

- 24 [1] J. Adam et al. (STAR) arXiv:2001.02852
25 [2] M.S. Abdallah et al. (STAR) arXiv:2101.12413